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SECOND YEAR SCIENCE/ARTS

Semester-III

MATHEMATICS HONOURS

CORE-5 Theory of Real Functions (Analysis-II)

Total Marks: 100

Credit 6 (Theory 5 + Tutorial 1)

Theory: 80 Marks + Mid-Sem: 20 Marks

Duration of Exam: 3 hours (End Sem. Theory), 1 hour (Mid Sem.)

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Analytical Properties of \mathbb{R} and \mathbb{C} : Open sets, Closed sets, Limit points (accumulation points), Closure, Interior and Boundary.

Unit-II

Limits of functions ($\epsilon - \delta$ approach), Cauchy criterion of limits of function, Sequential criterion for limits, limit theorems, Left and right hand limits, Infinite limits and limits at infinity, Continuous functions, sequential criterion for continuity and Discontinuity

Unit-III

Algebra of continuous functions, Continuous functions on an interval, Intermediate value theorem, Uniform continuity, non-uniform continuity criteria, uniform continuity theorem

Unit-IV

Differentiability of a function at a point and in an interval, Algebra of differentiable functions, Locally affine or differentiable functions, Left and right derivatives, Mean value theorems,

Unit-V

Indeterminate forms, Higher derivatives, and Taylor's theorem, Taylor's theorem with Lagrange's form of remainder, Maxima and minima.

Book Recommended:

G. Das and S. Pattanayak, Fundamentals of Mathematical Analysis, TMH Publishing Co. Ltd. New Delhi

Chapters: 5(5.1 to 5.5), 6(6.1 to 6.7, 6.9), 7(7.1 to 7.7).

Books for Reference:

1. R. Bartle and D. R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003

2. K. A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.

3. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999

4. S. R. Ghorpade and B. V. Limaye, A Course in calculus and real Analysis, Springer, 2006..

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SECOND YEAR SCIENCE/ARTS
Semester-III
MATHEMATICS HONOURS
CORE-6 GROUP THEORY-ALGEBRA-II

Total Marks: 100

Credit 6 (Theory 5+Tutorial 1)

Theory: 80 Marks + Mid-Sem: 20 Marks

Duration of Exam: 3 hours (End Sem. Theory), 1 hour (Mid Sem.)

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Definition and examples of Group, elementary properties of Group, Subgroup and examples of subgroups, Centralizer of an element and of a sub group, Normalizer, Center, Abelian group (definition and examples)

Unit-II

Left coset, right coset, order of an element, Lagrange's Theorem, A counting principle, Euler theorem, Fermat's theorem.

Unit-III

Normal subgroup, Quotient group, properties of normal subgroups, Homomorphisms, Isomorphism, fundamental Isomorphism theorem.

Unit-IV

Cauchy's theorem for finite abelian groups, Sylow's theorem for finite abelian groups, Automorphisms

Unit-V

Permutation groups, cycle notation, properties of permutations, even and odd Permutations, alternating groups.

Book Recommended:

I.N. Herstein: Topics in Algebra, (Second edition) Wiley Eastern Limited, India (2013)

Chapters: 2(2.1 - 2.8, 2.10)

Books for references:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edn.), Narosa Publishing House, New Delhi
2. John B. Fraleigh, A First Course in Abstract Algebra, 7th Edn., Pearson, 2002.
3. M. Artin, Abstract Algebra, 2nd Edn., Pearson 2011
4. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Edn. Springer Verlag, 1995.

SECOND YEAR SCIENCE/ARTS
Semester-III
MATHEMATICS HONOURS
CORE-7 Partial Differential Equations And Systems of
Ordinary Differential Equations

Total Marks:100

Credit 6(Theory 4+Practical 2)

Part-I(Marks:75) [Theory:60 Marks+Mid-Sem:15 Marks]

Duration of Exam:3 hours(End Sem. Theory),1hour (Mid Sem.)

4 Lectures,1 Tutorial(per week per student)

Unit-I

Simultaneous Linear First Order Equations in three variables ,Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Pfaffian Differential Equations ,Methods of solution of Pfaffian Differential Equations in three variables.

Unit-II

Partial Differential Equations of First Order: Formation of First Order Partial Differential Equations ,Linear and Non-linear Partial Differential Equations of First Order ,Special types of First-order Equations ,Solutions of Partial Differential Equations of First Order satisfying given conditions.

Unit-III

Partial Differential Equations of the Second and Higher Order :Linear Partial Differential Equations with constant coefficient ,Equations reducible to Linear Partial Differential Equations with constant coefficient ,Partial Differential Equations with variable coefficients Some Standard forms of variable coefficients ,Separation of variables(Product method).

Unit-IV

The Laplace Equation , Boundary value problem for Laplace's equation , Solution of Laplace equation by separation of variables .Solution of Laplace's equation for a disk.

Unit-V

One dimensional wave equation , Solution of the wave equation(method of separation of variables),D'Alembert's Solution of the wave equation ,Diffusion equation ,Solution of one-dimensional diffusion equation ,Method of separation of variables.

Book Recommended:

J.Sinha Roy and S.Padhy,A Course on Ordinary and Partial Differential Equations,Kalyani Publishers,New Delhi,Ludhiana,2012.

11,12,13(13.1 to 13.6 only),15(15.1,15.2,15.5,15.6 only),16(16.1 only),17 (17.1 to 17.3 only)

Books for References:

1.Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers,4th Edn.,Springer,Indian reprint,2006

2.S.L.Ross,Differential Equations 3rd Edn. ,John Wiley and Sons,India,2004.

CORE-7 PART-II (Practical: Marks:25)

List of Practical (Using any Software)

Practical/ Lab work to be performed on a Computer.

1. To find the general solution of the non-homogenous system of the form:
$$\frac{dx}{dt} = a_1x + b_1y + f_1(t), \frac{dy}{dt} = a_2x + b_2y + f_2(t)$$
with given conditions.
2. Program for finding roots of quadratic equation using Sridhar Acharya formula.
3. Plotting the integral surfaces of a given first order PDE with initial data.
4. Program for finding sum of digits of a number.
5. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:
 - (a). $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), x \in R, t > 0.$
 - (b). $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u_x(0, t) = 0, x \in (0, \infty), t > 0.$
 - (c). $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u(0, t) = 0, x \in (0, \infty), t > 0.$
 - (d). $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u(0, t) = 0, u(l, t) = 0, 0 < x < l, t > 0.$
6. Program to check whether a number is a palindrome or not.
7. Solution of wave equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:
 - (a). $u(x, 0) = \phi(x), u(0, t) = a, u(l, t) = b, 0 < x < l, t > 0.$
 - (b). $u(x, 0) = \phi(x), x \in R, 0 < t < T.$
 - (c). $u(x, 0) = \phi(x), u(0, t) = a, x \in (0, \infty), t \geq 0.$
8. Program to find twin prime numbers between 1 and n.
9. Arranging a given set of numbers in ascending order by using different techniques.
10. Program to find $x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$
11. Program to find $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots$

Mark Distribution: Experiment – 15, Record – 5, Viva – 5, Total – 25.

SECOND YEAR SCIENCE/ARTS

Semester-III

MATHEMATICS GENERIC ELECTIVE-II (A2/II)

Linear Algebra and Advanced Algebra

Total Marks: 100

Credit 6 (Theory 5 + Tutorial 1)

Theory: 80 Marks + Mid-Sem: 20 Marks

Duration of Exam: 3 hours (End Sem. Theory), 1 hour (Mid Sem.)

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Vector space, Subspace, Span of a Set, Linear Dependence and Independence, Dimensions and Basis.

Unit-II

Linear transformations, Range, Kernel, Rank, Nullity, Inverse of a linear map, Rank – Nullity theorem.

Unit –III

Matrices and linear maps, Rank and Nullity of a matrix, Transpose of a matrix, Types of matrices, Elementary row operations, System of linear equations, Matrix inversion using row operations, Determinant and Rank of matrices, Eigen values, Eigen vectors.

Unit-IV

Group Theory: Definition and examples, Subgroups, Normal subgroups, Cyclic groups, Cosets, Quotient groups, Permutation groups, Homomorphism, Isomorphism, Fundamental Isomorphism theorem.

Unit-V

Ring Theory: Definition and examples, some special classes of Rings, Ideals, Quotients rings, Ring homomorphism. Isomorphism theorems.

Book Recommended:

1. I.N. Herstein: Topics in Algebra, (Second edition) Wiley Eastern Limited, India (2013)
Chapters: 2(2.1 to 2.7 upto Theorem 2.7.1, 2.10), 3(3.1 to 3.4)
2. An Introduction to Linear Algebra: V. Krishna Murthy and Others (Affiliated East-West Press Pvt. Ltd.) Chapters: 3, 4(4.1 to 4.7), 5, 6(6.5, 6.6, 6.8 only),

Books for references:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edn.), Narosa Publishing House, New Delhi
2. S. Singh - Linear Algebra, Vikas Publishing House Pvt. Ltd. New Delhi
3. M. Artin, Abstract Algebra, 2nd Edn., Pearson 2011
4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Edn. Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
5. S. Lang, Introduction to Linear Algebra, 2nd Edn., Springer, 2005.
6. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning India Pvt. Ltd
7. S. Kumaresan, Linear Algebra - A Geometric Approach, Prentice Hall of India, 1999.
8. V.K. Khanna and S.K. Bhambri - A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd. New Delhi.

SECOND YEAR SCIENCE/ARTS

Semester-IV

MATHEMATICS HONOURS

CORE-8 Numerical Methods

Credit 6(Theory 4 +Practical 2)

Total Marks:100

Part-I(Marks:75)Theory:60 Marks+Mid-Sem:15 Marks

Duration of Exam:3 hours(End Sem. Theory),1hour (Mid Sem.)

4 Lectures,1 Tutorial(per week per student)

Unit-I

Errors: Absolute ,Relative and Percent errors ,Round off ,Truncation ,Numerical Solution of Non-Linear Equations :Bisection Method ,Secant Method ,Newton Raphson Method, Rate of Convergence of these methods .Fixed point of a Function and Fixed Point iteration Method.

Unit-II

Polynomial Interpolation: Existence and Uniqueness of interpolating polynomial ,Lagrange interpolating polynomial, Errors ,Newton's Divided difference interpolation polynomial Properties of divided difference ,Forward and Backward difference Interpolation polynomial

Unit-III

Numerical Integration :Some simple quadrature rules,Newton-Cotes rules,Trapezoidal rule Simpson's $1/3^{\text{rd}}$ rule ,Simpson's $3/8^{\text{th}}$ rule ,Midpoint rule,Composite Trapezoidal rule, Composite Simpson's rule ,Gauss quadrature rules ,Gauss-Legendre 2-point and 3-point rules.

Unit-IV

Numerical Solution of Differential Equations :Picards method ,Euler's method ,Modified Euler's method , Runge Kutta methods of orders two and four.

Unit-V

System of Linear Equations: Gaussian Elimination method ,Gauss-Jordan method ,Gauss-Jacobi Method and its convergence Analysis ,Gauss-Seidel Method and its convergence Analysis

C-8-2 Part-II (Practical:Marks-25)

List of Practicals (Using any Software)

Practical/Lab work to be performed on a Computer.

1. Calculate the Sum $\frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{N}$.
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending/descending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regula Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method
10. SOR Method or Gauss-Siedel Method.
11. Lagrange Interpolation or Newton Interpolation
12. Simpsons Rule
13. Trapezoidal Rule
14. Gaussian Elimination Method.

(Experiment:15 Marks+Viva:5 Marks+Record:5Marks=Total:25Marks)

Duration of Exam: 3 hours

Note:-For any of the CAS (Computer aided Software) Data types-simple data types ,floating data types ,Character data types ,arithmetic operator,operator precedence ,variables and constants, declarations ,expressions ,input/output ,relational operators ,logical operators and Logical expressions ,control statements and loop statements ,Array should be introduced to the students.

Book Recommended:

B.P.Acharya and R.N.Das,A Course on Numerical Analysis ,Kalyani Publishers ,New Delhi Ludhiana,

Chapters:1(1.8 only)2(2.1 to 2.4 & 2.6 to 2.9),3(3.1 to 3.4,&3.6 to 3.8),6(6.1 to 6.5,6.10&6.11)
7(7.1 to 7.4&7.7),8(8.1 to 8.3,&8.8)

Books for references:

1. M.K.Jain , S.R.K.Iyengar and R.K.Jain , Numerical Methods for Scientific and Engineering Computation,6th Ed. New Age International Oublisher,India,2007.
2. C.F.Gerald and P.O.Wheatley ,Applied Numerical Analysis ,Pearson Education,India,2008.
3. Uri M.Ascher and Chen Greif,A First Course In Numerical Methods,7th Ed. PHI Learning Private,Limited,2013
4. John H. Mathews and Kurtis D. Fink ,Numerical Methods Using Matlab,4th Ed. . PHI Learning Private,Limited,2012.

SECOND YEAR SCIENCE/ARTS

Semester-IV

MATHEMATICS HONOURS

CORE-9 Riemann Integration and Series of Functions (Analysis-III)

Total Marks: 100

Credit 6(Theory 5 +Tutorial 1)

Theory: 80 Marks + Mid-Sem: 20 Marks

Duration of Exam:3 hours(End Sem. Theory),1hour (Mid Sem.)

5 Lectures, 1 Tutorial(per week per student)

Unit-I & II

Riemann Integration ,Inequalities of Upper and Lower sums ,Riemann conditions of integrability ,Riemann sum and definition of Riemann Integral through Riemann sums ,equivalence of two definitions ,Riemann integrability of monotone and continuous functions ,Properties of the Riemann integral ,definition and integrability of piecewise continuous and monotone functions ,Intermediate Value theorem for Integrals ,Fundamental theorem of Calculus.

Unit-III

Improper Integrals ,Convergence Of Beta and Gamma Functions.

Unit-IV

Pointwise And Uniform Convergence of Sequence of functions ,Uniform convergence and continuity ,Series of Functions ,Term-by-term Differentiation of Series ,Term-by-term Integration of Series ,Weierstrass M-test Cauchy criterion for uniform convergence,

Unit-V

Limit superior and Limit Inferior ,Power Series ,Radius of convergence ,Differentiation and Integration of Power Series ,Abel's limit theorem ,Weierstrass Approximation theorem

Book Recommended:

G.Das and S.Pattanayak ,Fundamentals of Mathematical Analysis ,TMH Publishing Co.Ltd .New Delhi

Chapters:4(4.8,4.14),8(8.1 to 8.6),9(9.1 to 9.6 ,9.8).

Books for Reference:

1. R.Bartle and D.RSherbert ,Introduction to Real Analysis,3rd Ed. John Wiley and Sons,(Asia)Pvt.Ltd.,Singapore2002
2. K.A.Ross ,Elementary Analysis :The Theory of Calculus ,Undergraduate Texts in Mathematics ,Springer(SIE),Indian reprint,2004.
3. Charles G.Denlinger ,Elements of Real Analysis ,Jones & Bartlett(Student Edition)2011
4. S.C.Mallik and S.Arora-Mathematical Analysis ,New Age International Ltd. New Delhi.
5. Shanti Narayan and M.D. Raisinghania-Elements of Real Analysis ,S.Chand &Co. Pvt. Ltd..

SECOND YEAR SCIENCE/ARTS
Semester-IV
MATHEMATICS HONOURS
CORE-10 Ring Theory and Linear Algebra-I(Analysis-III)

Total Marks: 100

Credit 6 (Theory 5+ Tutorial 1)

Theory: 80 Marks + Mid-Sem: 20 Marks

Duration of Exam: 3 hours (End Sem. Theory), 1 hour (Mid Sem.)

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Ring –Definition and examples, some special class of rings , properties of rings ,Integral domain, Characteristics , Homomorphisms ,Isomorphism.

Unit-II

Ideals and quotient ring , more ideals ,maximal ideals,field of quotient of an integral domain.

Unit-III

Vector spaces, sub-spaces, span of a set, LD, LI, Dimension and Basis

Unit-IV

Linear transformation, Range , Kernel, Rank, Nullity, Composition of linear map.

Unit-V

Matrices, Matrix and Linear maps, Linear operations, Matrix multiplications, Rank, Nullity of a matrix, Elementary row operation, System of linear equation, inverse of a matrix, Determinant, Minor s and Rank of a matrix, Product of determinant, Eigen values and Eigen vectors

Book Recommended:

I.N.Herstein: Topics in Algebra,(Second edition) Wiley Eastern Limited, India(2013)
Chapters:3(3.1 to 3.4)

2.An Introduction to Linear Algebra:V.Krishna Murthy and Others(Affiliated East-West Press Pvt.Ltd.) Chapters:3,4(4.1 to 4.7),5,6(6.5,6.6,6.8 only)

Books for references:

1.Joseph A.Gallian ,Contemporary Abstract Algebra(4th Edn.) ,Narosa Publishing House ,New Delhi

2.John B.Fraleigh,A First Course in Abstract Algebra,&th Edn.,Pearson,2002.

3.M.Artin ,Abstract Algebra,2nd Edn.,Pearson 2011

4.Stephen H. Friedberg ,Arnold J.Insel ,Lawrence E.Spence ,Linear Algebra,4th Edn. Prentice Hall of India Pvt. Ltd ,New Delhi,2004.

5.S.Lang,Introduction to Linear Algebra,2nd Edn.,Springer,2005.

6.Gilbert Strang,Linear Algebra and its Applications , Cengage Learning India Pvt. Ltd

7.S. Kumaresan,Linear Algbra-A Geometric Approach,Prentice Hall of India,1999.

8.Kenneth Hoffman ,Ray Alden Kunze , Linear Algebra,2nd Edn. ,Prentice Hall of India Pvt. Ltd., 1971.